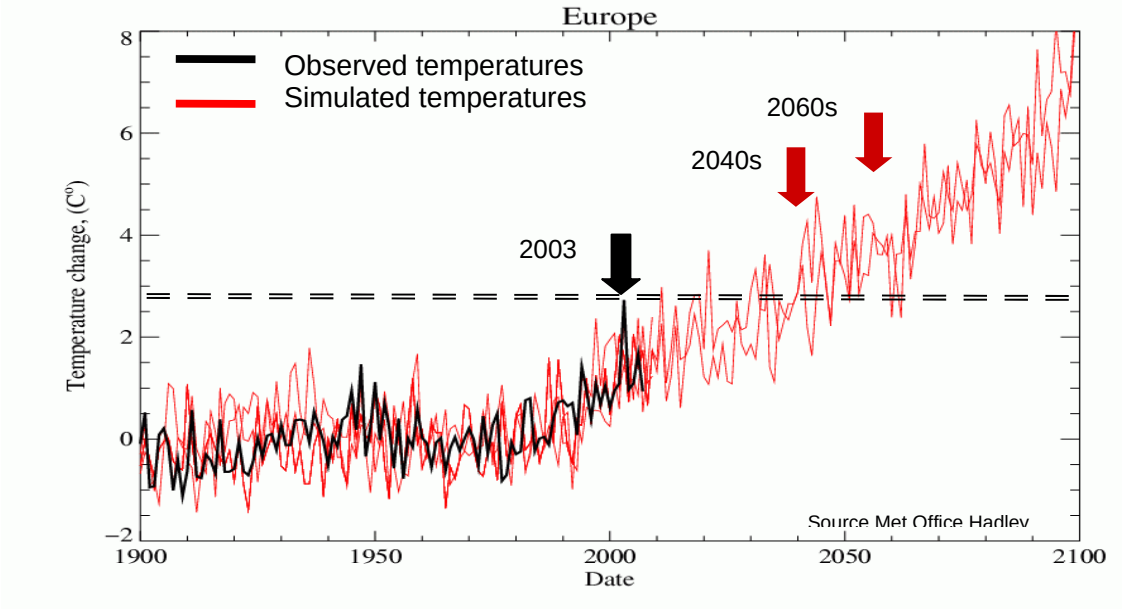
WESTERN POWER DISTRIBUTION

Serving the South West and Wales

Report on 2008/09 work undertaken under Ofgem Innovation Funding Incentive



Western Power Distribution (South West) plc
Western Power Distribution (South Wales) plc

WESTERN POWER DISTRIBUTION

CONTENTS

(Cover page - slide from presentation by Robin Mortimer - Director Adapting to Climate Change Programme - DEFRA July 2009)

1.0 INTRODUCTION

1.1 Western Power Distribution (South Wales) plc and Western Power Distribution (South West) plc hold electricity distribution licences issued by Ofgem under the Electricity Act (as amended). For brevity, "WPD" is used to refer to both licenced areas in this report.

1.2 During 2004, the Energy Regulator, Ofgem introduced an "Innovation Funding Incentive" (IFI) to encourage Distribution Network Operators (DNOs) to apply innovation in the way they pursue the technical development of their networks. This report describes WPD's IFI activities in 2008/9 and provides additional comments on use of previous research & development (R&D). WPD are required under the IFI scheme to complete a number of pro-forma report sheets, and these are included in Section 7 of this report.

2.0 OFGEM INNOVATION FUNDING INCENTIVE

2.1 The introduction of the Ofgem IFI mechanism in 2004 recognised that the risk/reward balance for research, development and innovation, differed from that applying to normal Distribution Network Operator (DNO) core business. IFI funded projects had to meet eligibility rules set out in Ofgem / DNO agreed documents.

2.2 Qualifying IFI projects have to meet criteria set out in the Ofgem IFI Regulatory Instructions and Guidance (RIG) and a Good Practice Guide which had to be developed by IFI parties and agreed by Ofgem. IFI work is partially funded, on a reducing sliding scale. Whilst DNOs could submit their own individual GPGs, there has been collaboration between DNOs in consultation with Ofgem, and a common GPG produced, as Energy Networks Association Engineering Recommendation G85, which received Ofgem agreement.

2.3 Building on experience gained during these initial projects, the RIGs and GPG were revised, and issue 2 of Engineering Recommendation G85 was issued in December 2007. As a consequence, of this, we have projects in 2008/9 which were commenced under different GPGs, with different definitions and reporting requirements.

2.4 The RIGs published by Ofgem and applicable to the 2006/7 financial year provided the following definition of an Eligible IFI Project:

A project will qualify as an eligible IFI project provided that it is designed to enhance the technical development of distribution networks (up to and including 132kV). Eligible IFI projects will embrace all aspects of distribution system asset management from design through to construction, commissioning, operation, maintenance and decommissioning.

2.5 The definition of technical development contained in the initial GPG, is as follows -

" In this context:

- "Technical" means "Being of a scientific and/or engineering nature and benefiting the design, construction, commissioning, operation, maintenance and decommissioning of the primary plant and equipment employed in the distribution of electrical energy and/or of the secondary plant and equipment employed to control, protect and maintain such Primary plant and equipment"

- "primary" means "heavy current equipment that carries power currents at voltages from LV up to and including 132kV"

2.6 In Issue 2 of "G85" the definition of "technical" was revised as follows -

- "Technical" means "Being of a scientific and/or engineering nature and benefiting the design, construction, commissioning, operation, maintenance and decommissioning and/or improving the direct environmental interactions of the Primary plant and equipment employed in the distribution of electrical energy, transmission or electrical energy and transmission of gas and/or the secondary plant and equipment employed to control, protect and maintain such Primary plant and equipment"

2.7 Ofgem have -

- established new RIGs with a rolling 5 year commitment to IFI,
- introduced a constant % support rather than a sliding scale reduction

2.8 This 2008/9 WPD IFI report uses the relevant GPG depending on date the project was initiated.

3.0 WPD's APPROACH TO RESEARCH AND DEVELOPMENT

3.1 Having regard to the need for prudent investment and use of resource, WPD's approach is to undertake targeted research on a range of short to medium term projects not having a high cost / high risk profile, normally through collaborative projects or programmes to gain added value and gearing. However, it is sometimes the case that collaboration in more speculative and blue sky research is pursued where the programme content is appropriate and there is very high gearing. The Supergen V EPSRC funded Amperes programme and Meteorological Office lead research on climate change impacts are examples. It is worthy of note that the Amperes programme was established under different EPSRC qualifying criteria than are now in place. Currently EPSRC focus is on Technology Readiness Levels (TRL) 1-3 where 1 is effectively "blue sky research" with no target development. The current GPG comments that Blue Sky research projects would not normally be considered eligible for IFI unless it can be demonstrated that there is an extremely good potential case and leverage from other funding is sufficiently great that it reduces the risk to the Network Operator to an acceptable and attractive level.

3.2 WPD have, in common with other DNOs, a long association of collaborative research working with EA Technology, Capenhurst, arising from the former Electricity Council Research Centre and the establishment of areas of UK expertise in specific and pertinent spheres of electricity distribution which are of relevance to WPD. Collaborative working has been undertaken with other UK DNOs and overseas partners in Strategic Technology Programme (STP) modules on substation, overhead line and underground cable subject areas. The costs of these are well below the de-minimis £80k per licence holder group as set in the GPG (section 5) for reporting at individual project level; programme level reporting is required.

3.3 In addition to work with EATL, WPD has previously engaged ERA Leatherhead and a wide range of other providers including Universities to undertake specific research work. Since April 2005, WPD has committed to supporting a large research proposal to EPSCR on Enhanced Management and Performance for a Sustainable UK Energy Infrastructure (Supergen V Amperes project), which would be heavily geared and involve collaboration with the Universities of Edinburgh, Liverpool, Manchester, Queens Belfast, Southampton and Strathclyde together with Industrial partners and other UK DNOs and transmission companies.

3.4 WPD recognises that it is sometimes valuable to commission research to provide a platform to facilitate debate on major issues. A current example has been the environmental life cycle research project with the University of Bath to provide data in support of network loss reduction issues, described more fully below. Under previous IFI work, WPD engaged in research on charging methodologies.

3.5 It is recognised that whilst research can often lead in the long term to real financial benefits, there are also significant benefits to the wider community through -

- network performance - improved reliability and resilience
- environmental - emissions, waste, visual impact etc
- safety to employees and public
- external risk mitigation
- knowledge transfer - acquisition and dissemination of knowledge,
- enhancing the quality and relevance of research through direct linkage with industry, development of the available "pool" of expertise, greater exposure of own staff to direct engagement with research activity

4.0 2008/9 PROJECTS

4.1 WPD's 2008/9 IFI Programme contained the following projects -

EATL STP Module 2 - Overhead Networks
EATL STP Module 3 - Cable Networks
EATL STP Module 4 - Substations
Supergen V Amperes - extensive EPSRC joint funded programme
ENA - Fault Level Monitor & Earthing projects
ENA - harmonic modelling
Met Office - climate change impact on energy networks
Met Office - climate change impacts on network resilience
University of Bath - life cycle assessment 11kV overhead line and underground cable
University of Strathclyde - Radiometric arc fault location
Elimpus - Helicopter mounted partial discharge locator
ADAS / Bartlett - Use of Tree Growth Retardant
WPD - Smart networks trial

Reports on these have been provided by research providers, collaborator partners and WPD, and are included in section 7 below. Additional comments and links to research partner web-sites are provided in the following paragraphs.

4.2 EATL STP web site www.eatechnology.com/STP_LearnMore.asp

4.3 Supergen Amperes www.Supergen.amperes.org.uk

SUPERGEN is an initiative managed and led by UK research councils and the Carbon Trust to support strategically important research in power engineering. It aims to help the UK meet its environmental emissions targets through a radical improvement in the sustainability of power generation and supply. The Energy Infrastructure Programme, one of 14 within SUPERGEN, is known as AMPerES (Asset Management and Performance of Electrical Systems).

The UK has a need to maintain reliability of energy supply at minimum cost in the context of ageing plant and a drive to deploy renewable and distributed generation. New forms of generation are changing loading characteristics of plant and system load flows. Increased use of power electronics will also change the nature of the waveforms that plant needs to cope with. The need to load particular parts of the system to maximise renewable output will also change the logistics of maintenance outages. To cope with this, a more rigorous view of risk is required which links individual items of plant, system requirements and system performance. In addition there is a need to address the environmental impact of transmission and distribution networks.

All the major UK Electricity network operators are involved in the project and in addition to their technical knowledge and network data, are contributing financial support. The Universities involved are those of Manchester, Southampton, Edinburgh, Liverpool, Strathclyde, and Queens University Belfast.

The two key aims of the project are; firstly to provide platform technologies and tools for integrated network planning and asset management; and secondly to identify methods to develop and implement networks with reduced environmental impact.

Core to the structure of this project is the integrated use of demonstration sites and activities. This provides a path of vertical integration through the project, bringing together the people working on the areas of material ageing, plant modelling, data acquisition and interpretation and optimal decision making. These demonstrators will pull together the world class research being carried out in the laboratories and allow the true value of condition monitoring to be identified, enabling appropriate business decisions on adoption of technologies.

The four-year project started in 2006 and is now fully resourced in all the universities. The project is on schedule to end in January 2010. A bid for renewal of the project for four further years is with EPSRC, and further details can be obtained from the project manager.

Many of the technologies being developed in this programme are likely to be utilised, however equally important is the broader window this work gives UK utilities to the global research community. In addition utilities and universities are learning to work in partnership, and developing young engineers who will provide the necessary skills base for the future.

4.4 Met Office research into climate change impacts on energy

www.metoffice.gov.uk/climatechange/buisinesses/casestudies/energy.html
www.metoffice.gov.uk/climatechange/science/projections/

also

http://ukcp09.defra.gov.uk

This work has provided a “state of art” view of forward climate impacts on the electricity networks and establishes a solid basis for reporting under the Adaptation Reporting Power in the Climate Change Act 2008 - see

www.defra.gov.uk/adaptation

Climate change Businesses Case studies

Impacts on Energy

The Met Office has been working closely with UK energy companies on EP2, an innovative project looking at the effects of climate change on the energy industry. This project is the first of its kind, being sponsored by an entire sector. It has resulted in companies across the industry forming a new energy and climate change group where they will share knowledge, experiences and best practice.

Energy project background

In 2006 the Met Office and three leading energy companies launched a pioneering scoping study into climate change and its potential impacts on the UK energy industry. The study was the first nationwide attempt to identify how climate change will affect energy generation; distribution and transmission, and demand. As well as initial indications on how climate change could impact the industry over the next century, it also identified areas where further research was required.

Following the scoping study an industry-funded project (EP2) was set up, involving 11 UK energy companies, focusing on the priorities identified by the earlier study.

Supported by climate scientists, experts from the industry worked together to understand their precise requirements and developed practical applications and business strategies for a changing world.

Energy project developments

So far EP2 has:

- Developed innovative new techniques that apply climate models to energy applications so that the industry is better placed to adapt to climate change
- Investigated future wind resource, enabling the industry to understand the continued uncertainty of future wind power. This will assist risk management and investment decisions
- Modelled future soil conditions and their impact on cables. This has helped companies understand the cost and benefits of installing cables for a more resilient future network
- Built a tool to enable UK coastal and marine sites of interest to be screened to assess if sea level rise should be considered in more detail
- Investigated how the urban heat island effect may change in the future, so that network companies can develop plans for their infrastructure in cities
- Produced guidance to help make best use of public information on climate change, such as the United Kingdom Climate Impacts Programme new scenarios of climate change
- Delivered new site-specific climatologies of temperature, wind speed and solar radiation that account for climate change, so that decisions can be based on realistic climate expectations
- Examined the relationship between historic weather patterns and network fault performance, with a view to developing a tool to predict future network resilience.

Energy project findings

Among the findings from the project were:

- With a few exceptions, such as the thermal ratings of equipment and apparatus, there is currently no evidence to support adjusting network design standards. For example, existing design standards for overhead line conductors do not require change
- The type of risk to transformers will be affected. Temperature thresholds will be exceeded more often and there will be more hot nights in cities
- Soil conditions will change - higher temperatures and seasonal differences in soil moisture are expected. Future conditions could be included in cable rating studies by increasing average summer soil temperatures in the models by approximately 0.5 °C per decade

- The output of thermal power stations (and in particular combined cycle gas turbines) could be suppressed, with higher air temperature meaning lower air density and lower mass flow. Conditions at each location should be considered, especially during redesign or new build and, if appropriate, adaptation planned
- Historical climatologies are no longer valid because climate is not stationary. The new climatologies that take account of climate change are already being adopted and will improve demand forecasting and planning out to 10 years ahead
- Wind resource is uncertain and understanding future resource represents a significant challenge. Although we don't yet have the answers, this project has highlighted possible strategies for improving our knowledge.

Energy project next steps

An energy and climate change industry group is to be set up. This group will:

- Share the latest science and its application to business
- Meet to discuss latest innovations and developments in climate science with leading experts
- Share thoughts and ideas on areas of common interest as companies work to adapt to climate change.

4.5 WPD Smart Network trial

The modification of existing pole and ground mounted HV/LV distribution s/s to capture the core electrical measurement parameters and communicate these back to central WPD server(s), including WPD ENMAC scada system, provides a platform for roll out of active network management or so called Smart Grids.

UK Government (and Opposition) envisage rapid need for evolution into such Smart Grids; the most recent being the announcements by Energy Minister, Ed Milliband on 15th July 2009, and the launch of the Low Carbon Transition Plan -

www.decc.gov.uk/en/content/cms/publications/lc_tran_plpan/lc_trans_plan.aspx

An extract from the report is shown below -

Box 10
Key elements of a UK smart grid

- Improved information for electricity consumers, notably through smart meters, to allow them to manage their energy use (and hence energy bills) more effectively.
- Facilitating demand management, providing data to technologies in homes and buildings that can regulate electricity use (e.g. encouraging electric cars to recharge when there is "surplus electricity" available on the system).
- Enabling individuals and businesses to sell electricity into the network as well as buying from it, through microgeneration and on-site technologies.
- Enhanced monitoring and information flows for network operators, allowing them to make more efficient decisions about where energy flows across the network on a real time basis. This is likely to be particularly important with increasing levels of intermittent renewable generation on the system. A greater use of energy storage would also increase the need for smarter information flows for network operators on energy storage supply and timing of its use.
- Use of a range of technologies including advanced communications and information management systems, intelligent metering, demand side management, and storage. Many of the technologies to enable such capability are already available, but have not yet been integrated together in large scale demonstrations and the actual mix that is deployed will depend on their feasibility.
- More optimal usage of the whole network in meeting demand, which could limit the need for more reinforcement of the grid.

5.0 COMMENATARY ON PREVIOUS PROJECTS

5.1 In respect of previous EATL STP projects, examples of WPD adoption of outputs include -

- Use of new conductors for overhead lines (case study reported last year)
- Alternatives to wood poles study was used to inform response to EU Biocides Directive
- Long rod polymeric insulators - used in WPD specification
- Surge arrester study - used in WPD specification
- High resolution imaging of tower lines - WPD policy revised to use technique as part of Condition Based Risk Management, which is allied to future Ofgem condition reporting requirements
- COST 727 ice loading study will inform future o/h line design requirements

5.2 There have been very many outputs from the Supergen work, and a few recent topical examples are -

- "machine learning" to identify equipment health degradation patterns from within multiple data streams that individually do not clearly indicate a trend, and chromatic analysis techniques.
- Findings on the impact of power quality harmonic content of measured partial discharge activity
- Tapchanger degradation measurement techniques
- Maintenance of synchronism of islanded generation
- Early identification of leaks from fluid filled cables
- Partial discharge sensor development
- Insulation paper degradation on power transformers

For a fuller list of papers - please see the Supergen Amperes website

www.Supergen.amperes.org.uk

6.0 FORWARD VIEW OF 2009/10 PROJECTS

6.1 In addition to existing committed projects from 2008/9 that run into 2009/10 WPD currently anticipate engagement in collaborative projects -

- Met Office research on climate change impacts on network resilience
- ADAS/ Bartlett research on use of tree growth retardants (already widely used on fruit trees but not elsewhere)
- Work by the Centre for Sustainable Electricity and Distributed Generation

6.2 Proposals are being developed for a Supergen renewal bid to EPSRC, and WPD will consider participation when EPSRC make a decision and the content is more fully determined.

7.0 PRO-FORMA REPORTS

WPD South West Summary report of IFI Project activities year ending March 31st 2009

Number of active IFI projects	13
NPV of costs and anticipated benefits from committed IFI projects	NPV of costs - £ 256,972 NPV of benefits - £ 640,247 Positive NPV - £ 383,275 (rounded from information on following sheets)
Summary of other benefits anticipated from active IFI projects	Enhanced asset health condition knowledge to inform future safety, reliability and replacement policy. Provision of timely expert information on lifetime carbon impact of overhead line and underground cable to inform current DPCR5 debate on loss reduction and carbon footprints. Provision of timely expert information on climate change impacts on electricity network assets to inform forward investment planning and debate, and respond to UK Government Adaptation Reporting requirements. Reductions in CMLs through improved reliability, resilience and speed Maintaining or improving safety to the public and staff. Reduction of environmental risk of oil loss from plant and cables. Move to roll out of widespread active network management capability on HV/LV substations in support of UK Government low carbon policy.
Total expenditure to date on IFI projects	£0.726 M up to end March 2009
Benefits actually achieved from IFI projects to date	Estimated £2.5M avoided capital cost through use of a novel overhead line conductor, deployed for the first time at 132kV, and, following tower strength assessments to BS EN 50341, needing minimal structural strengthening of existing towers. Knowledge on life cycle assessment carbon impact of 11kV o/h line and u/g cable has already proved valuable in DPCR5 discussion with Ofgem in EWG. The Climate Change impact collaborative Met Office project has provided an authoritative, fundamental, consistent industry wide basis for assessing future network rating impacts on the basis of best available forward projections. This work now facilitates debate on future investment planning. Economic Charging Method for Electricity Distribution Networks completed - Ofgem consulted and approved and now in use. Remote updating of switching schedules rolled out and delivering anticipated benefits in switching time. Changes to equipment specification. Use of high resolution imaging for tower health indices adopted into policy. Knowledge acquisition and transfer. Development of muti-mode condition monitoring techniques.

Regulatory report for DG incentive, RPZs and IFI **Reporting year 2008/09** **Western Power Distribution - South West**	
Innovation Funding Incentive	**£M**
IFI carry forward (£m)	**0.525**
Eligible IFI expenditure (£m) *	**0.154**
Eligible IFI internal expenditure (£m)	**0.039**
Combined distribution network revenue (£m)	**207.7**
* includes internal expenditure	

WPD Wales Summary report of IFI Project activities
Year ending March 31st 2009

Number of active IFI projects	13
NPV of costs and anticipated benefits from committed IFI projects	NPV of costs - £ 256,972 NPV of benefits - £ 640,247 Positive NPV - £ 383,275 (rounded from information on following sheets)
Summary of other benefits anticipated from active IFI projects	Enhanced asset health condition knowledge to inform future safety, reliability and replacement policy. Provision of timely expert information on lifetime carbon impact of overhead line and underground cable to inform current DPCR5 debate on loss reduction and carbon footprints. Provision of timely expert information on climate change impacts on electricity network assets to inform forward investment planning and debate, and respond to UK Government Adaptation Reporting requirements. Reductions in CMLs through improved reliability, resilience and speed Maintaining or improving safety to the public and staff. Reduction of environmental risk of oil loss from plant and cables. Move to roll out of widespread active network management capability on HV/.
Total expenditure to date on IFI projects	£0.726 M up to end March 2009
Benefits actually achieved from IFI projects to date	Knowledge on life cycle assessment carbon impact of 11kV o/h line and u/g cable has already proved valuable in DPCR5 discussion with Ofgem in EWG. The Climate Change impact collaborative Met Office project has provided an authoritative, fundamental, consistent industry wide basis for assessing future network rating impacts on the basis of best available forward projections. This work now facilitates debate on future investment planning. Economic Charging Method for Electricity Distribution Networks completed - Ofgem consulted and approved and now in use. Remote updating of switching schedules rolled out and delivering anticipated benefits in switching time. Changes to equipment specification. Use of high resolution imaging for tower health indices adopted into policy. Knowledge acquisition and transfer. Development of muti-mode condition monitoring techniques.

Regulatory report for DG incentive, RPZs and IFI **Reporting year 2008/09** **Western Power Distribution - South Wales**	
Innovation Funding Incentive	**£M**
IFI carry forward (£m)	**0.428**
Eligible IFI expenditure (£m) *	**0.154**
Eligible IFI internal expenditure (£m)	**0.039**
Combined distribution network revenue (£m)	**169.5**
* includes internal expenditure	

Eligible IFI Internal costs

The 08/09 IFI year has an abnormal % of internal costs for the following reasons -

- The current, large, Amperes Supergen project external costs were fully paid prior to the start of the IFI year, but the project has continued with a number of meetings and seminars. WPD have taken a lead role in being one of three network representatives
  (WPD, NG and SPPS) on the Project Executive behalf of the other participating network operators
- WPD have taken Chair of EATL STP Module 4, resulting in increased internal costs representing other DNO partners
- Costs have been met in 08/09 on agreed projects on resilience impacts of climate change and use of tree growth retardants, in advance of the external charges arising in the 09/10 IFI year.
- The smart networks trail was undertaken very rapidly to determine if a larger project proposal should be made to Ofgem during the DPCR5 submissions. It utilised WPD resource.

The overall internal / total IFI % from 2004/05 to 2008/9 inclusive, encompassing the above, is 16%.

Individual project reports on the following pages

Please note that the financial data stated in the following pages are the totals for WPD South West and WPD South Wales. This data has been apportioned 50/50 in the above summary sheets.

Project Title	Strategic Technology Programme Overhead Network Module 2		
Description of project	A DNO research & development collaboration hosted by EA Technology		
Expenditure for financial year	Internal £5,357 External £43010 Total £48,367	Expenditure in previous (IFI) financial years	Internal £2,736 External £43,010 Total £45746* NB only some of the projects span both 07/8 and 08/9
Project Cost (Collaborative + external + [DNO])	£310,102 + DNO	Projected 09/10 costs	Internal £ 2,800 External £45,629 Total £48429
Technological area and / or issue addressed by project	The Module 2 programme for budget year 2008/9 aimed to reduce costs and improve performance of overhead networks by increasing understanding of issues that have a negative impact on costs and performance. The programme is expected to also have a positive impact on safety and environmental performance. The projects all address real problems that have been identified by the module steering group members as significant and which require technical investigation and development. **Completed Projects (March 09):-** S2126_4 Monitoring conductor temperature at fixed current - at Cashlie and Queensferry; S2132_2 Validation of ice accretion models using Deadwater Fell; S2136_3 Continued involvement with European Project COST 727; S2138_2 Investigation of live-line jumper-cutting limitations; S2143_2 Develop in-situ degradation monitor for aluminium OHL conductors - Stage 2: Feasibility study; S2146_2 Torsion tests on composite insulators - Stage 2: Effect of torsion on tension insulators; S2149_2 High durability OHL fittings - Stage 2: Costing for testing prototype high durability fitting; S2150_1 Evaluation of TDR for assessment of tower foundations; S2152_1 Evaluate performance of Czech Icemeter at Deadwater Fell; S2153_1 Suitability of hand-held PD detector for condition assessment of pole-top equipment;		

<table>
<tr><td></td><td colspan="4">S2154_1 Experimental investigation of novel conductors - Stage 1: Icing;
S2156_1 Build Three Prototype Field Pole Leakage Current Detectors;
S2159_1 LV shrouding - review of current practices and standards

<u>Projects Still In Progress (March 09):-</u>
S2110_4 Extend OHRAT to include User Defined Covered Conductor
S2136_4 & 4A European Project COST 727: Measuring and forecasting atmospheric icing on structures, including Czech ice meter trial;
S2143_3 Develop in-situ degradation monitor for Al OHL conductors - Stage 3 Instrument Development;
S2147_2 Increasing vibration limit of CCs to 20%UTS using multiple std or single Hi-mass SVDs
S2151_2 Alternatives to wood poles - Stage 2: Erection and fitting trials on concrete poles
S2154_2 Experimental investigation of novel conductors at Deadwater Fell - Stage 2: Vibration;
S2157_1 Novel conductors for 132kV wood pole lines;

Updated information can be found at:- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">e.g. Incremental, Tech Transfer, Significant, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>15</td><td>-9</td><td>24</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">Projects in this module will significantly increase the safety and reliability of the network. In certain cases the asset life may also be extended.

If these projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO member of the programme to gain benefits including:
• Cost effective and early identification of damaged insulators and discharging components, which if not addressed would result in faults;
• Reduce levels of premature failure of assets and so avoid of risk of injury or loss of life or damage to property as a result of falling overhead lines;</td></tr>
</table>

	• Avoid redesign, reconstruction or refurbishment of overhead lines where this is driven by a perceived need to increase ratings or strengthen lines, and is required to conform with existing standards but which may be unnecessary; • Co-operation between European countries in the development of forecasting methods of atmospheric icing and for the exchange of forecasting tools; • Comparison of new covered conductor with known performance of older types • Extend the service life of towers and reduce potential levels of tower failures; • Review alternatives to wood poles; • Reduce lifetime costs by the appropriate use of alternative materials; • Give Members a better understanding of novel conductors for new-build or re-conductoring 132kV wood pole lines that gives lower capital cost, minimum visual impact, environmental acceptance than other methods of improving power transfer.		
Expected Timescale to adoption	Range 2-5 years - dependent on project	Duration of benefit once achieved	Range 2-10 years - dependent on project
Probability of Success	Range 10-50% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£64,624
Potential for achieving expected benefits	A number of STP Projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.		
Project Progress to March 09	Most projects or project stages started in the module during 08/09 have been completed, but some projects span more than one year.		
Collaborative Partners	Other DNOs		
R&D Providers	EA Technology		

Project Title	Strategic Technology Programme: Cables Module 3. (2008/09)		
Description of project	A DNO research & development collaboration hosted by EA Technology		
Expenditure for financial year	Internal £2210 External £53,681 Total £55 891	Expenditure in previous (IFI) financial years	Internal £ 2142 External £52116 Total £ 54258* NB only some of the projects span both 07/8 and 08/9
Project Cost (Collaborative + external + [DNO])	£375,767 + DNO	Projected 09/10 costs:	Internal £,2,300 External £55,291 Total £57591
Technological area and / or issue addressed by project	The STP cable network programme for budget year 2008/9 aimed at identifying and developing opportunities to reduce the costs of owning cable networks. The reduction of whole life cost through greater reliability and improved performance of cables and associated accessories comes under the remit of Module 3. Where appropriate, Module 3 worked with other Modules to achieve common goals. **Completed Projects (March 09):-** S3132_12 & 15: CRATER Near Real time Determination & functionality development; S3148_4 Requirements for earthing and bonding of single core MV power cables: feasibility of earthing and bonding of single core MV cable systems ; S3151_1 Understanding and controlling thermo-mechanical forces in cables systems: Study to assess work carried out on thermo-mechanical forces in cable systems; S3152_1 Separable connectors and cable compartments in 11 kV switchgear; S3153_1 & 2: Economics and environmental impacts of distribution cable losses: Model development including CO_2 burden calculation ; S3168_1 & 2: Comparing future designs of HV and EHV polymeric cables: Review of current specifications and designs and study to determine the interaction between resin and semi-conducting layers; S3169_1: Further studies on the retraction of insulation and over-sheath of cables; S3171_1: Jointing on to wet cables.		

<table>
<tr><td></td><td colspan="4"><u>Projects Still In Progress (March 09):-</u>
S3132_16: CRATER annotation;
S3144_2: Comparison of processes for the treatment of redundant fluid filled cables: Comparative field trials;
S3151_2 & 3 Understanding and controlling thermo-mechanical forces in cables systems: Modelling of thermo-mechanical forces in cable systems;
S3155_1 Trial testing of triplexed cable in plastic ducts;
S3157_1 Partial discharge testing of MV cable systems to provide asset risk management data;
S3164_1: Develop fluid filled cable design tool;
S3165_1: Performance ageing tests on polymeric terminations
S3166_1 & 2: Performance of cold- and heat-applied accessories under resin: Assessing interaction between resin and semi-conducting layer;

Updated information can be found at:- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">e.g. Incremental, Tech Transfer, Significant, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13</td><td>-8</td><td>21</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO Member of the programme to gain the following benefits, including:
offset future increases in CAPEX and OPEX;
CI/CML savings per connected customer;
Reliable, safe and easy to use method of detecting excess moisture in paper insulation of cables;
Reduce excavation required in locating leaks from fluid-filled cables, reduce the times and costs of leak location, and also reducing outage times;
Reduce cable purchase costs;
Reduce design costs.
Increased safety of staff and public by reducing the number of accidents / incidents.</td></tr>
</table>

Expected Timescale to adoption	Range 1-3 years - dependent on project	Duration of benefit once achieved	Range 2-10 years - dependent on project
Probability of Success	Range 15-50% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£87,318
Potential for achieving expected benefits	A number of STP Projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.		
Project Progress to March 08	Most projects or project stages started in the module during 08/09 have been completed, but some projects span more than one year.		
Collaborative Partners	Other DNOs		
R&D Providers	EA Technology		

Project Title	Strategic Technology Programme: Substations Module 4. (2008/09)		
Description of project	A DNO research & development collaboration hosted by EA Technology		
Expenditure for financial year	Internal £ 5698 External £39,223 Total £ 44921	Expenditure in previous (IFI) financial years	Internal £ 5880 External £38080 Total £ NB only some of the projects span both 07/8 and 08/9
Project Cost (Collaborative + external + [DNO])	£313,784 (08/09)	Projected 09/10 costs: £323,200	Internal £ 6,000 External £40,400 Total £46,400
Technological area and / or issue addressed by project	The aim of the 08/09 Substation Programme was to develop already well established themes such as life extension of aged assets within legal and heath and safety constraints, examination of new technologies, developing an understanding of, and innovative solutions for, the impact on substation assets of increasing levels of distributed generation on networks and condition monitoring techniques. The majority of projects have not only resulted in essential knowledge transfer, they have enabled skills to be developed between STP 4 Members and European partners. Key examples of this were the participation in the AM Forum, (S4185_4), reviewing how transformers are connected within Europe (S4221 _2), each of which has contributed significantly to developing better understanding of electrical plant, improving safety implications, utilisation, performance and life cycle. Some of these projects have resulted in the creation of further supplementary projects for 2009/2010. **Completed Projects (March 09):-** S4164_5: Tap changer monitor stage 5; S4178_2: Impedance Testing of Substation Batteries; S4181_3: Ongoing Programme Of Transformer Post Mortems; S4209_2: Post Maintenance Testing: Project Workshop Jan 09; S4222_2: Alternatives to ENATS 35-1 Transformers: Extension 315KVA Ground Mounted Transformers; S4233_1: 145kV Earthing switch Asset Management Manual; S4235_1: Researching New Techniques for Optimising Plant Maintenance Policies; S4237_1: Battery Cabinet Temperature Control; S4238_1: Module 4 Information Dissemination; S4239_1: Research and Testing of Electrical Contact Cleaning Products; S4241_1: Study of Circuit Breaker Timing Measurements & Methods; S4244_1: Review of methods to dissipate pressure in Substations during equipment failure;		

<table>
<tr><td></td><td colspan="4"><u>Projects Still In Progress (March 09):-</u>
S4164_5: Tap changer monitor stage 5;
S4178_2: Impedance Testing of Substation Batteries;
S4185_4: European AM Forum Membership 08/09;
S4221_2: Out Of Phase Modelling Report;
S4224_1: X/R Extrapolation of 12kV Vacuum circuit Breakers;
S4226_1: Environmental Corrosion, Specification, Testing of Plant & Equipment;
S4230_1: Optimisation of Operational Support and Response for Electrical Plant & Equipment;
S4236_1: Aquagen recombination system;
S4245_1: Switchgear - Effect of Low Power Factor Switching. (Joint Investigation with STP5: S5181_1).

Updated information can be found at:- https://www.stp.uk.net</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">e.g. Incremental, Tech Transfer, Significant, Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>14</td><td>-9</td><td>23</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">If the projects are technically successful and the findings and recommendations from the projects are implemented, then the projects will potentially enable each DNO Member of the programme to gain the following benefits, including:
• offset future increases in CAPEX and OPEX;
• CI/CML savings per connected customer;
• Preventing disruptive failures of oil-filled equipment, tapchangers, earth switches increasing safety and avoid unnecessary scrapping of serviceable components will alleviate environmental impact.
• Liaison with European Utilities to share new technology and failure modes;
Increased safety of staff and public by reducing the number of accidents / incidents.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">Range 1-5 years - dependent on project</td><td>Duration of benefit once achieved</td><td>Range 2-8 years - dependent on project</td></tr>
</table>

Probability of Success	Range 10-100% - dependent on project	Project NPV = (PV Benefits – PV Costs) x Probability of Success	£67,777
Potential for achieving expected benefits	A number of STP Projects are at an early stage and the project cost may not always reflect the likely full costs of implementation. These will be identified providing the outcome of the early stage is positive. However, STP has delivered a number of notable innovations since its inception.		
Project Progress to March 08	Most projects or project stages started in the module during 08/09 have been completed, but some projects span more than one year.		
Collaborative Partners	Other DNOs		
R&D Providers	EA Technology		

ENA R&D Programme 2008-09

The Energy Networks Association (ENA) represents all UK DNOs & National Grid. The project listed below has been initiated by the ENA R&D Working Group and has been funded through the IFI.

<table>
<tr><td>Description of project</td><td colspan="5">Further investigation into the potential impacts of climate change on network resilience - Feasibility Phase</td></tr>
<tr><td rowspan="3">Expenditure for financial year</td><td>External</td><td colspan="4">£ nil in 08/09</td></tr>
<tr><td>Internal</td><td colspan="4">£ 445</td></tr>
<tr><td>Total</td><td colspan="4">£ 445</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="4">£</td></tr>
<tr><td>Internal</td><td colspan="4">£</td></tr>
<tr><td>Total</td><td colspan="4">£ Nil</td></tr>
<tr><td>Total Project Costs (Collaborative + External + Company)</td><td colspan="2">External (nil to date)
£ 445</td><td colspan="2">Projected 2009/10 costs for Company’s</td><td>External £ 3315
Internal £ 1000
Total £ 4315</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">Future reliability of the distribution and transmission network is important to ensure continuity of service and to minimise unforeseen costs. This work will investigate the potential impacts of a changing climate on future network fault numbers.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2" rowspan="2">Incremental and Significant innovation types are involved.</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>12</td><td>-9</td><td>21</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">The result of this work would inform Licensee's strategy with regard to IIP performance incentives which impact on Price Controls, system planning studies and operational preparedness for extreme weather events. For example, the benefits of intervention options such as tree cutting and installation of equipment such as lightning arrestors will be influenced by how fault numbers are expected to change. The study will also inform a debate as to whether the industry Security and Quality of Supply Standards should be adjusted to accommodate climate change.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">2012</td><td colspan="2">Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">75%</td><td colspan="2">Project NPV (Present Benefits - Present Costs) x Probability of Success</td><td>£ 8,000</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="5"></td></tr>
</table>

Project Progress **March 2009**	The first workshop was held on the 22nd April 2009 with representatives from each energy company, the Met Office and the ENA to discuss and agree how the industry would utilise and benefit from further network resilience research. To facilitate this discussion a number of questions were provided and each was considered on 3 different timescales: 5 days, up to 10 years and up to 50 years. Using the information obtained during the workshop, we outline the optimum user requirements for each time scale below. 1. <u>5 days:</u> An operational fault risk alert system, including - high spatial resolution (license/county level at minimum), and - at least 3 days warning with 6 hourly updates. 2. <u>Up to 10 years & 50 years:</u> A report and interactive tool including - changes in fault frequencies, fault durations, CIs and CMLs, - changes in number of days where fault numbers are less than the exceptional event threshold, - information provided seasonally at a license/county level, and - all associated uncertainties quantified. The user requirements for the two longer time scales (up to 10 and 50 years) were found to be very similar and have consequently been combined. The time scales will, however, be dealt with separately when considering whether the requirements can be met since different methods may be necessary for the two time periods. In all cases faults will be normalised; this will remove any license area differences and allow a standardised UK representation to be analysed. During May and June 2009 months work will be undertaken to carry out the feasibility study. During this time we will carry out a literature review, assess data availability for fault and climate variables and determine how the user requirements could be met. The output of this study will be provided in a report, which will include: • Agreed user requirements. • Literature review of similar work. • Data availability (for both fault and climate). • Assessment of the Met Office's capabilities and how the user requirements could be met. Particular focus on assessing the confidence of climate projections. • Recommendations: the minimum and optimum outputs of further study. A second workshop will be held on 23rd June 2009 to discuss these outputs specifically, the recommendations for further study. At this point we hope to obtain a industry consensus on the direction of further study on network resilience.
Collaborative Partners	National Grid, Scottish Power Energy Networks, Scottish and Southern, ENW, Western Power Distribution, Central Networks, CE Electric & EDF Energy Networks.
R&D Providers	Met Office

ENA R&D Programme 2008-09

The Energy Networks Association (ENA) represents all UK DNOs & National Grid. The project listed below has been initiated by the ENA R&D Working Group and has been funded through the IFI.

<table>
<tr><td>Description of project</td><td colspan="4">To develop new techniques to assess the impact of lower voltage earth electrodes on higher voltage ‘hot zones’, and to measure the resistance of distribution substation earth systems.</td></tr>
<tr><td rowspan="3">Expenditure for financial year</td><td>External</td><td colspan="3">£ 2250</td></tr>
<tr><td>Internal</td><td colspan="3">£ 392</td></tr>
<tr><td>Total</td><td colspan="3">£ 2642</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="3">£ 4074</td></tr>
<tr><td>Internal</td><td colspan="3">£</td></tr>
<tr><td>Total</td><td colspan="3">£</td></tr>
<tr><td>Total Project Costs (Collaborative + External + Company)</td><td colspan="2">External £ 27,000</td><td>Projected 2009/10 costs for Company’s</td><td>External £ 7125
(Proposal only)
Internal £
Total £0.00</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="4">All designs for earthing systems consider the effects of touch and step potentials under fault conditions. However the quantity of concern is actually the current flowing through a human body when in contact with metalwork subject to this potential and the time the current flows for. An electrode simply sited in soil which has a surface potential cannot be regarded as presenting the same hazard as metalwork with a direct metallic connection to the earth fault current return path. However there exists at this time no methodology for assessing the either the hazard posed by such an earth electrode or the possible effects of the earth when connected to a distributed system on the ROEP contours.

This project will if successful determine these effects and provide a means to provide cost effective safe earthing systems without the need for extensive separations between HV and LV electrodes which in a PME system may be impractical to achieve and maintain.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental and Significant innovation types are involved.</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>8</td><td>-5</td><td>13</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="4">The project will determine the effects of LV earth systems on HV systems. The results of this should determine the means to provide cost effective, safe earthing systems without the need for extensive separations between HV and LV electrodes which in a PME system may be impractical and costly to achieve and maintain.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">2 years</td><td>Duration of benefit once achieved</td><td>10 years</td></tr>
</table>

Probability of Success	50%	Project NPV (Present Benefits – Present Costs) x Probability of Success	*
Potential for achieving expected benefits	High. The results from tests and simulations can be used to propose a recommended procedure for measuring transfer potential between HV and LV systems, suitable for inclusion in a DNO policy document. No NPV benefits are currently claimed by WPD in the light of European debate over related EN Standard, the consequence of which would be to increase separation, not decrease it. However the outputs of this research will be used to influence those EN proposals, as mentioned below in the ENA comment.		
Project Progress **March 2009**	During the first four phases of the project (as per IFI 2007-2008) the project team were able to confirm by calculation and measurement (including analysis at two live substations) that the LV electrode system interacts with the external potentials created by a close, but electrically separated HV installation. The findings are completely new and help to explain why there is so little evidence of damage to LV equipment when there is an HV earth fault on equipment quite close by. It was possible to quite closely match the theoretical and measured results at the two live test substations but they were each considerably ore complicated that the vast majority of installations in terms of their earthing requirements. Because the finding are so new and unexpected there is a need to carry out the following: (1) Theoretical and practical measurements at a simple substation whose earthing arrangements match what is or should be done at the majority of sites throughout the UK. (2) Use computer models of similar and improved earthing arrangements for the same type of substation to develop several case study examples. These will consider changes to the electrode orientations, separation distances, electrode depths etc. Not only will these help explain the effects, but they will also be used to develop more appropriate earthing strategies rules and support equations. The case studies will be documented in a manner that permits publication. (3) Make the findings known in the UK, Europe and Internationally. The main reason for this is to ensure that the new practices become established and for this they must be reflected in the standards that are presently being developed. (4) Prepare text describing a method for calculating the transfer potential for inclusion in ENA TS 41-24 The work set out above for phase 5 is anticipated to take 15 months to complete.		
Collaborative Partners	Scottish Power Energy Networks, Scottish and Southern, ENW, Western Power Distribution, Central Networks, CE Electric & EDF Energy Networks.		
R&D Providers	Strategy & Solutions		

ENA R&D Programme 2008-09

The Energy Networks Association (ENA) represents all UK DNOs & National Grid. The project listed below has been initiated by the ENA R&D Working Group and has been funded through the IFI.

<table>
<tr><td>Description of project</td><td colspan="5">To commission a study and develop guidance for long underground cable harmonic impedance modelling.</td></tr>
<tr><td rowspan="3">Expenditure for financial year</td><td>External</td><td colspan="4">£ 8997</td></tr>
<tr><td>Internal</td><td colspan="4">£ 0</td></tr>
<tr><td>Total</td><td colspan="4">£ 8997</td></tr>
<tr><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>External</td><td colspan="4">£</td></tr>
<tr><td>Internal</td><td colspan="4">£</td></tr>
<tr><td>Total</td><td colspan="4">£ 0.00</td></tr>
<tr><td>Total Project Costs (Collaborative + External + Company)</td><td colspan="2">External
£62982.23 (Exc Vat)</td><td colspan="2">Projected 2009/10 costs for Company</td><td>External £
Internal £
Total £0.00</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">The report covers the detailed modelling of cable and overhead line components. Particular attention is paid to cable models appropriate for distribution networks, as this is was the initial objective of the project and literature on modelling of cables is not as widespread as that for other items of equipment.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td rowspan="2">Incremental and Significant innovation types are involved.</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td colspan="2">Overall Project Score</td></tr>
<tr><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">The study objective is the development of an ETR type guidance note to supplement G5/4 (2001) and help reduce and simplify modelling requirements for relatively small capacity 33kV and 11kV connections</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">2 years</td><td colspan="2">Duration of benefit once achieved</td><td>20 years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">75%</td><td colspan="2">Project NPV (Present Benefits – Present Costs) x Probability of Success</td><td>£ 6,000</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="5">The frequency dependent behaviour of overhead lines and cables was assessed. A sensitivity analysis has shown that simplified models and power frequency models may be used to represent the harmonic behaviour of a single core conductor overhead line and cable with a reasonable degree of accuracy over the frequency range assessed.</td></tr>
</table>

Project Progress **March 2009**	An interim report has been issued following the first section of work on the cable modelling which addresses the technical cable modelling issues on the original project brief. The extension to the brief to stage 2.5 as it is called is the focus of the final report which is taking the time and will not be available until the meeting of the working group on the 9th of July 2009.
Collaborative Partners	ScottishPower Energy Networks, Scottish and Southern, ENW, Western Power Distribution, Central Networks, CE Electric & EDF Energy Networks.
R&D Providers	TNEI

ENA Fault Level Monitor Project

Project Title	Fault Level Monitor Project					
Description of project	An ENA co-ordinated project the objective of which is the development of an on-line instrument that can successfully measure / estimate fault level on a distribution network with repeatability and reliability.					
Expenditure for financial year	Internal External **Total**	£ nil £1,225 **£1225**	Expenditure in previous (IFI) financial years		Internal External **Total**	£2,400 £8,000 **£10,400**
Project Cost (Collaborative + external + [DNO])	**£190,000**		Projected 09/10 costs		Internal External **Total**	£2,000 £30,550 **£32,550**
Technological area and / or issue addressed by project	The device will connect to the network, and establish the network source impedance from small-scale disturbances / perturbations resulting from transformer tap changer operation, etc. This impedance can accurately be correlated to a true network fault level for that location, providing near real-time information to network control and planning engineers alike.					
Type(s) of innovation involved	Incremental	Significant	Technological substitution	Radical		
	No	Yes	No	No		
Expected Benefits of Project	The developed unit will allow the DNOs to accurately assess fault infeed levels and design distribution networks appropriately. The particular benefits of this project are seen to be: • Provide a real-time and consistent estimation of fault level • Accurately take into account all connected network elements (e.g. Motors); • Facilitate the connection of distributed generation by providing a standardised methodology for the assessment of network fault levels • Enable an ongoing assessment of the effects of connected distributed generation to be made; • Provide reassurance to generator developers that decisions to upgrade networks are not subjective but based on objective measurement.					
Expected Timescale to adoption	3 years		Duration of benefit once achieved	10 years		
Probability of Success	25%					
Project NPV	(Present Benefits x Probability of Success) - Present Costs			£92,045		

Project Progress to March 09	The results of the tests carried out at NaREC show that the EA Technology Fault Level Monitor is capable of delivering an assessment of both the source and motor infeed elements of fault level. The accuracy of the assessment can be delivered with the tolerance levels (+/- 5%) which were set down by ENA OSG sub-group. However, it should be noted that the instrument is based on a hardware platform which is obsolete and no longer supportable. Stage 2 of the previous work carried out in conjunction with the University of Strathclyde, was intended to develop a new Fault Level Monitor. Consideration should be given to the need to carry out further development of a new platform to collect and analyse the disturbance data.
Potential for achieving expected benefits	The confidence limits in the case of the induction motor infeed assessment were affected by the relatively low number of recorded disturbances and also appear to have been affected by the 'two-stage' nature of many of the disturbances. Further work should be undertaken to examine the effect of the load response of non-linear static loads on the estimate of fault level contribution from induction motors. A PhD studentship at the University of Strathclyde the PNRA to explore this issue is being advertised.
Collaborative Partners	National Grid, Scottish & Southern Energy, CE Electric UK, Electricity North West, Central Networks, Western Power Distribution, EDF-Energy Networks
R&D Providers	University of Strathclyde, EA Technology

Radiometric Arc Fault Location

<table>
<tr><td>Project Title</td><td colspan="5">Radiometric Arc Fault Location</td></tr>
<tr><td>Description of project</td><td colspan="5">Applied research, and follow up installation of a system to triangulate fault locations on overhead lines from the high frequency radio wave signatures produced from an arcing fault.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="2">Internal £1,213
External £15,950
Total £17,163</td><td>Expenditure in previous (IFI) financial years</td><td colspan="2">Internal £
External £
Total £ nil</td></tr>
<tr><td>Project Cost (Collaborative + external + DNO</td><td colspan="2">£292,000</td><td>Projected 08/09 costs</td><td colspan="2">Internal £1,000
External £7,700
Total £8,700</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">• The principle of the technology is:
• There is a correlation between RF discharges and network faults on overhead lines with the RF signal being picked up by a radio antenna up to around 70km away
• If antennae are spread across the network, a mesh is formed - in a similar manner to the GSM network
• If a fault can be accurately clocked, triangulation can be used from a number of base stations to give an approximate geographic location (accuracy ~300m) and linked to GIS / SCADA data to give a more accurate fault location.</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td>Incremental</td><td>Significant</td><td>Technological substitution</td><td colspan="2">Radical</td></tr>
<tr><td>No</td><td>Yes</td><td>No</td><td colspan="2">No</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">If successful, the use of radiometric ‘cells’ could be used to accurately locate fault locations on all overhead line networks within that zone.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">3 Years</td><td>Duration of benefit once achieved</td><td colspan="2">10 Years</td></tr>
<tr><td>Probability of Success</td><td colspan="5">25%</td></tr>
<tr><td colspan="4">Project NPV (Present Benefits x Probability of Success) – Present Costs</td><td colspan="2">£45,787</td></tr>
<tr><td>Project Progress June 09</td><td colspan="5">3 of the 4 monitoring sites have been brought into service:
Shotts - Dec 2008; Kirkintilloch and Bellshill Feb 2009, with Dealain House to be brought online in May 2009 (some equipment problems are delaying this last site being commissioned)
• All 3 are collecting large amounts of radiometric data,
• A number of correlations have been made between SP fault records and the data collected</td></tr>
<tr><td>Potential for achieving expected benefits</td><td colspan="5">The project has achieved a degree of success already and the analysis of the data collected so far is ongoing. As the project has progressed and more ‘in the field’ experience has been gathered it has become possible to make changes to the equipment setup which allow the sensitivity of the equipment to be increased and data to be gathered more quickly thus increasing the chances of success.</td></tr>
<tr><td>Collaborative Partners</td><td colspan="5">Western Power Distribution, Scottish & Southern Energy, Central Networks, Electricity North West, CE Electric UK SPEN</td></tr>
<tr><td>R&D Providers</td><td colspan="5">University of Strathclyde</td></tr>
</table>

Impact of Climate Change on the UK Energy Industry

<table>
<tr><td>Project Title</td><td colspan="5">Impact of climate change on the UK Energy Industry</td></tr>
<tr><td>Description of project</td><td colspan="5">In 2006 the Met Office carried out a scoping study on the impacts of climate change on the UK energy industry. The report was the result of a collaboration between E.ON UK, EDF Energy, National Grid and the Met Office Hadley Centre to scope the impacts of climate change on the UK energy industry.

This Phase 2 project was industry-funded; it involved 11 UK energy companies and was undertaken by the Met Office. It focussed on the priorities identified by the earlier scoping study.

During the project new tools and methods required to understand the impact of climate change on the energy industry were developed and new data resources designed to address gaps in underpinning information were produced.</td></tr>
<tr><td>Expenditure for financial year</td><td colspan="5">External £ Nil (fully paid in 2007/8)
Internal £2123
Total £ 2123</td></tr>
<tr><td>Expenditure in previous (IFI) financial years</td><td colspan="5">External £29,306
Internal £ 2,668
Total £31,974</td></tr>
<tr><td>Total Project Costs (Collaborative + external + EDF Energy)</td><td colspan="2">£ 554,000</td><td colspan="2">Projected 2009/10 costs</td><td>External £
Internal £
Total £ Nil</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">The project has been run as a series of work packages (WP). Those WPs relevant to distribution and transmission are described below.
WP1 - Modelling Energy Impacts. Models created to assess impacts of climate change on Electricity Demand, Conductor Performance, Transformer Performance, Cables, Overhead Network, and Wind Power.
WP2 - Guidance for the Energy Industry on the use of the United Kingdom Impacts Programme new scenarios of climate change (UKCIP08). UKCIP08 is planned for released in November 2008.
WP3 - Climate Models and Wind Projections. Investigating methods of including estimated of future wind resource in wind farm viability.
WP4 - Climate Change and Underground Cable Performance. Modelling future soil conditions to increase understanding of the impacts of climate change on cables.
WP6 - Climate change and the Urban Heat Island Effect. Producing information on the urban heat island for use when panning infrastructure in cities.
WP7 - Final reporting and presentation of the results to each company.
WP8 - Predicted climatologies for the UK: 2008 - 2018</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td colspan="2" rowspan="2">Incremental
Significant
Technological substitution Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td>Overall Project Score</td></tr>
<tr><td>13.6</td><td>-2.0</td><td>15.6</td></tr>
</table>

Expected Benefits of Project	The expected benefits of project are: • For the elements assessed an understanding of the sensitivity to climate change and key meteorological drives of the impacts. This will highlight priorities for adaptation. • New models for projecting impacts suitable for inclusion in climate models or for application to climate model output. • Guidance on the application of climate models to energy industry applications which should results in appropriate use of climate information by Networks. • New information on urban heat islands and climatologies for the next 10 years to assist infrastructure design and planning.		
Expected Timescale to adoption	Year 2011	Duration of benefit once achieved	20 Years
Probability of Success	50%	Project NPV (Present Benefits - Present Costs) x Probability of Success	£ 100,000
Potential for achieving expected benefits	There is a good chance of achieving the expected benefits. This was a year long project that finished at the end of May on time and to budget and specification. Project outputs and reports are now available via the project website. The project has highlighted some areas of Networks where no change to existing practice is required because of climate change and other areas where adaptation may be beneficial. The new models that have been developed and used in this project will be a useful legacy. The new information produced specifically for the energy industry has been demonstrated to have significant benefits over what was available previously.		
Project Progress **March 2008**	In March 2008 the status of the project work packages was as follows: WP1 - Complete WP2 - 50% Complete WP3 - Complete WP4 - 90% Complete WP6 - 90% Complete WP7 - 50% Complete WP8 - 80% Complete Overall the project was 75% complete.		
Collaborative Partners	All the network operators and most energy supply businesses		
R&D Provider	Met Office		

SUPERGEN - AMPERES

<table>
<tr><td>Project Title</td><td colspan="5">Supergen V - AMPerES</td></tr>
<tr><td>Description of project</td><td colspan="5">Supergen is an EPSRC strategic partnership programme incorporating a collection of projects across a number of UK academic establishments. This fifth call, Supergen V is entitled Asset Management & Performance of Energy Systems (AMPerES).</td></tr>
<tr><td rowspan="3">Expenditure for financial year</td><td>Internal</td><td>£6,487</td><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>Internal</td><td>£13958</td></tr>
<tr><td>External</td><td>£nil</td><td>External</td><td>£100,000</td></tr>
<tr><td>Total</td><td>£6487</td><td>Total</td><td>£113958</td></tr>
<tr><td rowspan="3">Project Cost (Collaborative + external + SP-EN)</td><td colspan="2" rowspan="3">£ 2,800,000</td><td rowspan="3">Projected 08/09 costs for WPD</td><td>Internal</td><td>£4,000</td></tr>
<tr><td>External</td><td>£nil</td></tr>
<tr><td>Total</td><td>£4,000</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">WP 1: Programme delivery, outreach and implementation
WP 2: Enhanced network performance and planning
WP 3: Adaptable protection and control techniques
WP 4: Infrastructure for reducing environmental impact
WP 5: Ageing mechanisms
WP 6: Condition monitoring techniques</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td>Radical</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td colspan="2">Overall Project Score</td></tr>
<tr><td></td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">The expected aims of the project are:
To deliver a suite of intelligent diagnostic tools for plant
To provide platform technologies for integrated network planning and asset management
To progress plans to develop and implement improved and reduced environmental impact networks
To develop models and recommendations for network operation and management</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">10 years</td><td>Duration of benefit once achieved</td><td colspan="2">20 Years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">25%</td><td>Project NPV</td><td colspan="2">£62k</td></tr>
</table>

Potential for achieving expected benefits	Asset management is core to the business. The appropriate use of the emerging opportunities for condition monitoring is key to optimising performance, both financially and in quality of supply. Some of the technologies being developed in this programme are likely to be utilised, however much more important is the broader window this work gives to the global research community. Through demonstration sites the true value of condition monitoring will be identified, enabling appropriate business decisions on adoption of technologies.
Project Progress **June 2009**	Technology & trials: • The detection, control and protection synchronous islands have been demonstrated on a 50kVA diesel generator. The demonstration employs a real-time phasor measurement system. An AC optimal power flow method for assessing the maximum distributed generation (DG) penetration in distribution networks has been developed. A novel method of detection of loss of grid techniques is being developed. A low-cost system with internet broadcast capability has also been developed: four are currently in operation. An investigation into how regions of a distribution network can operate during emergency islanded mode conditions is also underway. • Optimized design of existing overhead lines of wood pole line, and a lattice tower line. The methodology has been employed to analyse the behaviour of low-sag composite conductors on a 33kV wood-pole structure. The model is now being utilised on a wood-pole line on Scottish Power and a lattice tower line on the National Grid, and may substantially improve the performance of sections of the network without major infrastructure changes. • A unique installation for transformer monitoring at National Grid comprising of two 275/132kV, 180MVA transformers, is implementing results of research on condition monitoring architectures, diagnostics and machine learning. • Development of condition monitoring architecture for power networks has progressed well and is being implemented on a National Grid transmission transformer. Diagnostic and support modules are included, and exploit a range of ageing models including those developed within this project. Work on ageing has shown that the rate of damage may not be affected by harmonic content, but resulting partial discharge signals change significantly. • PP-based alternatives to XLPE cable insulation have been characterised. Additional funding has been secured for the more applied work to develop routes to commercial exploitation. Vegetable oils have been shown to be a basis for replacement of mineral oils in HV equipment. • Strathclyde and Liverpool have been applying knowledge-based partial discharge analysis and chromatic analysis to data from EdF Energy cable monitoring systems. All publications and reports are available to all the partners from a secure web site: http://www.supergen-amperes.org/
Collaborative Partners	National Grid, Scottish Power, Scottish and Southern, United Utilities, Western Power Distribution, Central Networks, CE Electric, NIE, Advantica & EDF Energy Networks.
R&D Provider	Universities of Manchester, Southampton, Edinburgh, Liverpool, Strathclyde, Queens (Belfast).

WPD SMART NETWORK TRIAL

<table>
<tr><td>Project Title</td><td colspan="5">Smart Network Trial</td></tr>
<tr><td>Description of project</td><td colspan="5">To equip all HV/LV pole and ground mounted distribution s/s fed from one 132/66/11 kV primary s/s, with measurement facilities to capture loading information and communicate back into WPD corporate systems including ENMAC scada.</td></tr>
<tr><td rowspan="3">Expenditure for financial year</td><td>Internal</td><td>£53,100</td><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>Internal</td><td>£ nil</td></tr>
<tr><td>External</td><td>£44,000</td><td>External</td><td>£ nil</td></tr>
<tr><td>Total</td><td>£97,100</td><td>Total</td><td>£ nil</td></tr>
<tr><td rowspan="3">Project Cost (Collaborative + external</td><td colspan="2" rowspan="3">£97,100</td><td rowspan="3">Projected 08/09 costs for WPD</td><td>Internal</td><td>£53,100</td></tr>
<tr><td>External</td><td>£44,000</td></tr>
<tr><td>Total</td><td>£97,100</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">To trial and demonstrate acquisition of measurement quantities from existing legacy main network equipment, monitor and communicate back to WPD corporate IT systems including ENMAC scada system. The project work contains the following elements -

• Selection of appropriate readily available hardware units for monitoring, metering, communicating, and housing.
• Developing risk assessed installation techniques covering a wide range of legacy distribution system assets to which the above will be fitted
• Establishing communication links to a WPD data server
• Monitoring meter outputs / communication path continuity
• Provide rapid loss of supply indication
• Assessment against existing apportionment and modelling approaches</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td>Technological substitution from different application</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td colspan="2">Overall Project Score</td></tr>
<tr><td></td><td>11</td><td>0</td><td colspan="2">11</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">• Enhanced Network Utilisation - savings to Customers
• Facilitating active network management, to deliver the management of substantially increased intermittency associated with expanded distributed generation, demand side management and wider use of electric vehicles
• Providing ready connections and comms link for distribution substations to be used as data aggregation hub for two way data collection / control of domestic smart meters.
• Providing the data required for site specific cost benefit analysis of loss reduction measures, such as early replacement of higher loss distribution transformers
• Providing monitoring of voltage, power factor and harmonic content, leading to maintenance / improvement of power quality
• Enhanced speed of outage detection</td></tr>
</table>

Expected Timescale to adoption	1 year	Duration of benefit once achieved	40 year main equipment, 15 years technology refresh
Probability of Success	50%	Project NPV	£45k
Potential for achieving expected benefits	Utilisation and loss reduction benefits already demonstrated. The extent of use of the installations as part of active network management will be influenced by Government decisions on domestic smart meters, and initiatives for management of intermittency, and WPD are actively engaged in this debate.		
Project Progress **June 2009**	Technology & trials: The project was initiated in December 2008 and installations completed by 5th February 2009 with all data successfully flowing and assessed by 13th March 2009. Data display via Enmac demonstrated. A proposal for wide scale roll out has been developed and a number of presentations and demonstrations have been provided to senior staff of Ofgem and DECC.		
Collaborative Partners	None for this demonstration trial. Discussions on subsequent proposal have taken place with a number of major manufacturers.		
R&D Provider	EATL - work on statistics of CT accuracy		

HELICOPTER MOUNTED PARTIAL DISCHARGE DETECTION – FEASIBILITY TRIAL

<table>
<tr><td>Project Title</td><td colspan="5">Helicopter mounted partial discharge detection feasibility trial</td></tr>
<tr><td>Description of project</td><td colspan="5">The University of Strathclyde and the spin off company Elimpus, have developed ground based systems for locational detection of partial discharges using time of flight systems. One of these utilises an array of aerials contained within a van mounted “roof box”; a size compatible with the aerial separation that might be achieved between the skids of a typical Jet Ranger or Squirrel helicopter employed by DNOs for overhead line patrols. A small feasibility trial was undertaken to asses the viability of a larger IFI project that would entail development of equipment suitable for CAA flight certification.</td></tr>
<tr><td rowspan="3">Expenditure for financial year</td><td>Internal</td><td>£517</td><td rowspan="3">Expenditure in previous (IFI) financial years</td><td>Internal</td><td>£ nil</td></tr>
<tr><td>External</td><td>£6393</td><td>External</td><td>£ nil</td></tr>
<tr><td>Total</td><td>£6910</td><td>Total</td><td>£ nil</td></tr>
<tr><td rowspan="3">Project Cost (Collaborative + external</td><td colspan="2" rowspan="3">£19,696</td><td rowspan="3">Projected 09/10 costs</td><td>Internal</td><td>£ 500</td></tr>
<tr><td>External</td><td>£3000</td></tr>
<tr><td>Total</td><td>£3500</td></tr>
<tr><td>Technological area and / or issue addressed by project</td><td colspan="5">Can ground source partial discharges in open terminal substations be reliably detected from a helicopter?</td></tr>
<tr><td rowspan="2">Type(s) of innovation involved</td><td>System prototype / trial</td><td>Project Benefits Rating</td><td>Project Residual Risk</td><td colspan="2">Overall Project Score</td></tr>
<tr><td></td><td>10</td><td>-7</td><td colspan="2">17</td></tr>
<tr><td>Expected Benefits of Project</td><td colspan="5">If so the project would offer the ability to quickly scan EHV open terminal s/s as part of routine overhead line patrols, offering improved reliability at low incremental patrol cost.</td></tr>
<tr><td>Expected Timescale to adoption</td><td colspan="2">2 years</td><td>Duration of benefit once achieved</td><td colspan="2">10 years</td></tr>
<tr><td>Probability of Success</td><td colspan="2">25%</td><td>Project NPV</td><td colspan="2">£5k</td></tr>
</table>

Potential for achieving expected benefits	Asset health assessment is key to delivery of network reliability and safety performance. The feasibility trial employed existing technology, but stand off distance and disturbance from the helicopter and its systems, posed potential challenges. A minimal NPV has been included above, as a subsequent project would be needed to deliver a flight certified solution.
Project Progress **June 2009**	Technology & trials: Flight trial has demonstrated the ability to detect ground based discharge activity. At the time of writing it not yet determined if some other activity was not detected.
Collaborative Partners	Central Networks, Scottish & Southern
R&D Provider	Elimpus / University of Strathclyde

WPD / BATH UNIVERSITY - LIFE CYCLE ASSESSMENT 11kV OVERHEAD LINES AND UNDERGROUND CABLES

Description of project	Life cycle assessment of 11kV overhead line and underground cable -				
Expenditure for financial year 08/09	Total £ 15,000	External £ 15,000	Internal £ nil	Expenditure in previous financial years per WPD Licence area	£ 702
Technological area and / or issue addressed by project	To gain an understanding of the "embedded" carbon and carbon emission associated with the material extraction, treatment, manufacture, shipping, installation, operation, inspection, maintenance, and end of life action for three ratings of 11kV overhead line and two nearest equivalent ratings of underground cable.				
Type(s) of innovation involved	Incremental				
Expected Benefits of Project	The purpose of the project is to inform debate on - • Initial sizing of conductor to reduce losses and carbon footprint • The merits of early replacement intervention to reduce losses and carbon footprint • The merits of amending the current loss incentive mechanism, having regard to carbon				
Expected Timescale to adoption	1 year				
Estimated Success probability (at start of project)	100% - in providing data, 10% in radical change to loss incentive				
PV of Project Costs	£ 15,700	PV of Project Benefits	£500,000	NPV of Project	£183,000
	The above NPV benefit is derived from this work supporting a move to a "holistic" NPV life time assessment view of the treatment of losses. NPV assessments in relation to low loss t/fs and non tapered LV cables has been passed to Ofgem and on these a lifetime NPV saving (using full costed losses) amounts to > £2M per Licence, or > £200K if a 10% "success" factor is applied				
R&D Provider	University of Bath				

8.0 NOTE ON NET PRESENT VALUE

8.1 There are several approaches to net present value assessments of research type work. One approach is to scale up test discount rates to reflect the "riskiness" of a project whilst another is to employ a standard test discount rate and employ a success probability factor, for example 25, 50, 75%. The latter was described in a report commissioned by Ofgem on Innovation in Electricity Distribution Networks and prepared by Mott MacDonald/BPI in March 2004, and is the approach employed by WPD.

8.2 Experience of the typical payback of successful projects undertaken within an STP Module is typically in the range of 6 - 8 X investment, which success probabilities of the programme projects tends to be at the 25% band. Timescales of individual projects within an STP Module are of the order of 3 years, with break milestones built in. The test discount rate employed is the WPD cost of capital from DPCR4, i.e. 6.9%. The average duration of benefit once a successful project has been achieved has been assessed as 10 years.

8.3 Whilst it is possible that the effect of some financial benefits might be taken into account by Ofgem in a subsequent Distribution Price Control Review (DPCR), Customers would continue to receive the benefits of such successful research and so our NPV benefit calculations do not terminate at 2010, the date of the next DPCR.